

the **CustomSound**[®] series

Installation Guide

CW160R
CW160S

psb
SPEAKERS

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I. MATERIALS AND TOOLS

The only other materials necessary to install CustomSound speakers are paint and extra fine sandpaper if you wish to change the color of Grills and/or Finish Frames from their standard white. Of course, wire cable of appropriate length and size will be necessary to connect speakers to amplifiers (or volume controls) in the music system.

A. Required Tools

The following tools are needed for normal, simple installations:

Tape Measure, Pencil, and Level
Utility Knife and Wallboard Saw (and extra blades)
Philips Screwdriver and Putty Knife
Drill and Bits (smaller for lead holes and larger for cabling)
Probe Wire (a heavy coat hanger can substitute for a short fish-tape)
Flashlight

B. Other Tools

Particularly when installing a quantity of speakers, or installing in wood paneling or other wall materials, the following tools are desirable for neater and more efficient installations:

Stud Finder (helpful—particularly with simple, wallboard-on-studs construction)
Metal Straight Edge (Ruler or Framing Square) and Masking Tape
Wallboard Rasp/Sanding Block (or a piece of wire lath around a block)
Awl or Worn Screwdriver (for initial, exploratory holes) and Hammer
Wire Cutters/Strippers and Electrical Tape
Battery Screwdriver and Power Drill and Extensions (with extra bits)
Jig Saw and Blades
Wallboard Router and Cutout Bits

II. LAYOUT

A. Listening Locations

Consider the desired, intended, and probable locations of listeners when considering speaker locations. Ideally, listeners should have a clear line-of-sight/hearing to all speakers in their listening area—not too far off axis and not obstructed by structure or furnishings—for most balanced frequency response. Where will listeners be—primary and secondary? Where will listeners' ears be—sitting, standing, walking? No installation is absolutely ideal, but considering listener locations with speaker location can greatly improve the final result—and simplify the effort and expense to achieve it.

B. Speaker Locations

Here are three simple ideals, which are never fully satisfied:

1. Locate speakers equidistant to listeners, preferably at ear level.
2. Locate speakers closer to each other than their distance from listeners.
3. Locate speakers symmetrically to each other and to their physical surroundings.

Ideally, listeners will be equidistant from front right and left and center channel speakers and from rear (or side) left and right surround channels for most accurate spatial imaging. If listeners are too close to front or to rear channel speakers the image cannot come together and flow seamlessly across. While ear-level mounting is ideal, the swivel tweeters can be aimed towards the listeners, increasing the accuracy of frequency response when speakers are located further off axis from listeners' ears. Most importantly, a center

channel speaker should be located centered on the TV screen—to keep center channel sound coming from the center of the screen..

Balance adjustment can compensate for some physical location difference between left and right. Time-delay adjustment of surround sound can compensate for some physical location difference between front and rear. With mono signals equidistant, symmetrical location is still desired to minimize balancing requirements. Proximity to additional side wall, ceiling or floor surfaces will cause increases and decreases in frequency response which are very difficult to electronically equalize for smooth response overall—particularly when only some of the speakers are affected.

Ceiling locations are generally good locations, particularly for rear channel and secondary listening, allowing symmetrical layouts and the increased volume between floor joists for improved bass response. Some sound output will transmit through the wall behind (or floor above) a speaker; and, while this can be lessened with insulation and other installation techniques, it should be considered in finalizing locations.

All CustomSound models are designed to maintain the same tonal balance when different models are mixed in a system. The same model should be used in symmetrical listening locations in a system—front left and front right; rear left and rear right.

Each CustomSound speaker carton contains a full-size template of the front of the speaker. These templates can be used when initially locating speakers and then when marking and cutting out speaker locations. We encourage temporarily taping templates in the intended locations and then sitting in the primary listening location and considering the above guidelines again—also realizing that behind-the-wall conflicts will probably require some adjustment to the intended locations before they are final.

C. System and Supply

Typically, a cable with a wire pair must connect every speaker to the sources. This amplified and controlled source supply may go directly from a power amplifier or through a local, supplemental volume control. In some, mono-only systems, a single wire may "daisy chain", entering and exiting from one speaker to another—beginning and ending at the amplifier.

Overall, a musical source—audio or video—is fed first through a preamplifier with switching and tone controls—and then through a power amplifier and onwards to each speaker. The preamplifier provides a level of tone controls—bass, treble, and balance left to right. Surround processors, operating between the preamplifier and amplifier stages, can provide surround decoding and another level of channel balancing—front left, right, and center; surround left and right; and subwoofer. An equalizer before the amplifier can provide some adjustment to smooth response for field conditions and preferences. Multiple amplifiers may be used for multiple zones and speaker loads.

D. Obstructions

With tentative speaker locations determined, potential obstructions must be explored and the conflicts resolved: Structural; Mechanical—Electrical, Plumbing, and HVAC; and Furnishings.

Temporarily mark and view tentative speaker locations and the existing construction carefully to determine the existing structure and mechanical installations and potential obstructions. Adjust the speaker layout, the furnishings, the mechanical, and/or the structural to resolve the conflicts. Layout, review, and resolution on building plans can be a very efficient process. However, some conflicts will inevitably appear and need to be resolved as actual conditions are reviewed and as installation proceeds.

Most typically and very basically, residential walls are constructed of wooden

studs—nominally 2" x 4", but measuring 1½" x 3½" (sometimes, particularly on exterior walls 2" x 6", measuring 1½" x 5½") and normally located on 16" centers—with 14½" between studs. This stud pattern usually begins from one, exterior corner and results in a smaller than normal spacing at the other corner. The full height "common" studs extend from a flat "sole" plate on the floor to a "top" plate (often doubled) at the top of the wall. Top headers of doubled 2" x 4"s (or larger) are placed on edge spanning over doorways and windows, and doubled sill headers run under window openings. "Trimmer/jack" partial studs run under the ends of all headers, doubled against full studs against the ends of all headers. Shorter partial "cripple" studs run over headers to the top plate and under sills to the bottom plate—at nominal spacing. Blocking may be between studs about mid-wall, behind cabinets and other fixtures mounted to the wall, and over and under ductwork through the stud cavity. Electrical receptacles and switches are mounted in electrical boxes, usually mounted to a stud. Removing electrical cover plates in finished walls is a good initial step to determine where studs are located.

Floors typically are constructed of wooden joists—nominally 2" x 8" or deeper, but measuring 1½" x 7¼" or deeper and normally located on 16" centers (but not uncommonly on 12" centers). Roofs typically are constructed of wooden rafters—nominally 2" x 6" or deeper, but measuring 1½" x 5½" and located on 16" centers (but not uncommonly on 24" centers). Ceilings are usually backed by 1" x 3" strapping leveled beneath the floor joists or roof rafters and located on 16" centers.

Electrical cables run to, and most often from, all electrical boxes—which are grouped on circuits. Plumbing supply, drain and vent lines run to and from all plumbing fixtures—which are grouped on vertical risers. Heating supply lines circulate through radiation fixtures—which are grouped in zones off vertical risers. HVAC ductwork runs to all supply grills and from all return grills. Control wiring (sometimes tubing) runs to all controls.

Corner bay locations should be avoided since at least one corner bay is usually smaller than normal, which will decrease bass response, and closeness to the side wall will cause some unevenness in frequency response. Mechanical activity that occupies volume in the speaker wall cavity will decrease bass response and may transmit sound to other, unintended areas. Electrical power wiring should not run close to the speaker or its audio supply; crossing away from the speaker and its supply has minimal effect.

E. Weather Resistance

CustomSound speakers are designed for outstanding durability as well as outstanding sonic performance. Polypropylene cones with rubber surrounds, stainless steel fasteners, aluminum grills, and ABS plastic frames with UV resistance increase the range of locations where CustomSound speakers can continue to satisfy. It should be remembered that nothing is fully weatherproof (or soundproof or fireproof). Salt water, driving rains, direct sunlight, and freeze and thaw cycles will degrade all materials—even granite—over time. Almost any interior locations other than submerged, baked, or frozen are fine. Good exterior locations provide some protection from the weather, and these are usually also better locations for improved sonic performance. Porch ceilings and walls are fine. On exterior walls, some weather shelter is desirable—under overhanging eaves is fine. Totally exposed, unsheltered locations will not sound as good and will deteriorate over time.

F. Tricks of the Trades—Nothing's Plumb, Square, or True

All people in construction realize that it is an exacting but inexact craft—nothing is exactly, absolutely plumb, square, or true. The craft is to understand and respect the tolerances of materials, tools, makers, and users—what will look right to the eye, is reasonably possible to build, and will retain its position over years—within the budgets of money and time. Planning, measuring, and coordinating are important; but conflicts, tradeoffs, and imperfections are inevitable in the final construction. Pre-construction drawings are very

valuable to further the process mentally before the physical begins. Post-construction, as-built drawings are valuable to assure performance and aid modification. However; no drawings will be entirely complete or consistent with the construction. Proceed with an open and responsive mind. Prepare to be surprised, challenged, and rewarded—to solve the many small riddles along the path to completion.

III. INSTALLATION

A. New Construction

The PSB in-walls covered in this manual use a particularly effective mounting technique with toggle style mounting clamps. They are so named because the mounting clamp toggles out from a rest position prior to tightening down. As shipped, this mounting clamp parks on a flat on its mounting tower, thus staying out of the way for easy insertion of the system into the wall cutout. When a screwdriver is applied to the mounting screws it first turns the clamp 90 degrees, removing it from its resting place, and then brings the clamp down a track in the tower. With further tightening it finally clamps the wall firmly. This clamping style gives firm clamping for freedom from rattles, and great convenience of installation. The round and square models (CW160R and CW160S) have 4 each.

A template is provided for marking the speaker cutout. It has a series of slots for tracing the cutout and also an outline of the system to confirm that the flange won't interfere with any wall features.

For the new construction application, we offer Back Box and Pre-construction Bracket solutions. The Back Box (BBX-88) defines the optimal enclosure volume for our CustomSound Series products and is mounted between two studs behind drywall. The result is optimal low frequency response and an improvement in adjacent room isolation. The Pre-construction Brackets simplify installation in new construction application and can be used with or without the Back Box. The round model is the CK-6R and the square version is the CK-6S. Installation instructions are provided with both products.

At each intended speaker location measure and mark with a pencil the intended center of the speaker. Near the intended center make a small initial exploratory hole with an awl or (worn) screwdriver and hammer, a wallboard cutout saw, or a drill. If the awl, screwdriver or saw hits "solid" after the wallboard or plaster is pierced or if the drill produces sawdust after the initial wallboard/plaster dust, you have probably hit a wooden stud—which will obstruct that location. If drilling becomes harder after piercing the wallboard or plaster, remember it could be plumbing, mechanical, or electrical material. If you feel unusual resistance or sense an obstruction, stop. Consider the situation and carefully make another small exploratory hole about 1 1/2" to the side where you would prefer the speaker location to move.

When your small exploratory hole avoids obvious obstruction, enlarge that hole slightly with the screwdriver and hammer (or wallboard saw) until you can extend a short probe wire/fish-tape through the hole and determine the location of the stud on each side and other obstructions. Adjust your layout if necessary and then enlarge the hole slightly so that you can see into the wall cavity (aided by a flashlight) and confirm there are no further obstructions.

Continue this process of initial layout, exploratory holes, determining hole, and confirming hole at each intended location in a related group before proceeding with full cutouts. You can then modify the initial layout as required to avoid the inevitable discovered conflicts and maintain a desired layout for acoustical performance and visual aesthetics—while avoiding and minimizing any excess cutting and patching.

When final speaker locations are determined, use the template by placing it on the wall at the intended system location. Several thumbtacks can hold it in position. (Put the thumbtacks within the outline of the system and their holes won't show later.) Use a pencil or fine tipped pen to trace around the slots of the template. Bias the pencil or pen towards the inside of the slots to achieve the proper dimensions. A cutout of the dimensions determined by the template will include a little play to allow for cutting variation.

Now cut out the full rough-opening being careful to avoid over-cutting, breaking edges of the opening, or damaging surrounding paint or wallpaper finishes. A wallboard handsaw, preferably with replaceable blades, is the normal tool. The Finish Frames are about 3/4" wide around the Grilles on the finish surface and extend about 5/8" beyond the rough opening cutout, which should be quite adequate cover with reasonable care in layout and cutout.

Check that openings are large enough and plumb by test fitting the speaker into the opening. A wallboard rasp block/plane is very useful to slightly expand and square up openings. A small level on or against the Frame easily confirms level and plumb.

Place the system into the wall cutout. If there is extra slack in the cutout then level and position the system before tightening the screws or after slightly tightening one or two of the screws. Use a number 2 Philips head screwdriver or any style and size that properly fits the screw head. Note: using bits that are too small will lead to damaging the screw head and may make it very difficult to sufficiently tighten or untighten the mounting screws.

Initial tightening may take considerable force as the screw forms a thread through the mounting leg. This will loosen as the screw continues to turn. Set driver torque with just enough force to start the screw turning. DO NOT OVERTIGHTEN. The system has been well designed to prevent stripping or damage from over tightening but PSB cannot be responsible for damage due to unreasonable force being used when mounting the system.

Should it ever be necessary to remove the system from the wall, then unscrew each leg (counter clockwise) in turn. As you unscrew the screw head will lie flat in the frame until near the end of its travel, where the screw starts to rise. STOP AT THAT POINT. Further turning will remove the screw from the assembly and will make it more difficult to remove the system. The dog leg clamps are held at the top of the mounting tower and should not fall off or down into the wall cavity, unless excessive force and continued counter-clockwise turning are used.

When each mounting screw is back out as described above you should be able to remove the system. Because the clamps are not parked in the starting position as when the system was first mounted, some of them may interfere with the system's removal. Usually some wiggling can jostle each clamp into a position where it isn't interfering. Using a manual screwdriver to apply slight counterclockwise pressure should also turn a clamp out of the way. (Start with the screws on one end of the system and turn each slightly. Angle the system out a little more as each clamp moves out of the way.)

B. Enclosure Volume and Insulation

CustomSound speakers are designed for optimum performance in standard wall cavities. A normal studded wall cavity is about 3 1/2" x 14 1/2" x 93" with a volume of about 2.7 cubic feet (75 liters). Changes in cavity volume most affect bass performance—response and maximum output. Slightly wider or narrower stud spacing and the resulting cavity volume will not significantly affect performance. Significant increases in cavity depth and the resulting volume—50% more with 2" x 6" wall studs or more than twice as much with floor joists—contribute to improved, more easily attainable bass performance. Volumes

less than half the design volume will curtail bass performance and should be avoided.

Reaching through the rough-in opening and adding a bead of glue or caulking along the junction of the stud and the wallboard at both sides of the opening, both front and back, will increase the stiffness of the cavity enclosure near the speaker. This will also provide insurance against possible buzzing from air movement in the cavity.

Bass response is affected by the shape of the wall cavity, as well as by the size and resulting volume of the cavity. Sound radiated from the speaker driver inside the cavity reflects back from the boundaries of the cavity. The strongest effects are resonances at the frequencies whose wavelengths are multiples of the cavity dimensions, which emphasize or de-emphasize these specific frequencies—with resulting unevenness in overall response. Several, straightforward steps will avoid and lessen these negative effects:

1. Do not locate speakers at the mid-points of wall or ceiling cavities—where the distance from the speaker driver to both ends of the wall cavity will be the same and resonance effects will be doubled. One-third and one-quarter points should also be avoided for the same reason, although the negative effects will be less.
2. Have standard (unfaced) fiberglass insulation loosely fill the wall cavity, (or at least at both ends of the cavity and at the mid-points between the speaker driver and the ends in both directions). This insulation allows the sound to travel through in both directions, but mixes the lengths of travel and absorbs some sound energy (particularly resonant sound) as heat to lessen any resonant effects. If the wall cavity is fully insulated, it should be left in place, removing only a portion of the insulation directly behind the speaker system to avoid physically obstructing the normal operation of the system or over-damping the sound output. The insulation also reduces transmission of sound through the cavity rear wall to neighboring spaces.

IV. WIRING

A. Rough-in Wiring

Typically, a cable with a wire pair connects each speaker to the signal sources, either directly or through a local volume control. The speakers must be wired appropriately for the intended control. The impedance loads of speakers must be balanced with the capabilities of the amplifier(s). In some, mono only systems a single wire may "daisy chain", entering from one speaker to another—beginning and ending at the amplifier. If bi-amplification or bi-wiring is desired for increased dynamic response and power handling, a second cable pair of wires must be run to the speaker. Wire size should increase with longer runs—usually 16 AWG stranded copper wire is minimal, with 12AWG desirable for longer runs. Additionally, a control wire is required to any IR sensor installed on a speaker baffle. Audio cable should avoid the electrical power wiring to avoid interference, which can be audible—never running directly adjacent to it and crossing at right angles, when necessary. Holes are normally located in the middle one-third of the framing depth to minimize structural effects. If wire is within 1" of the front face of the framing, it should be covered with (standard) steel protection plates to prevent later fasteners from piercing the cable.

Wiring should be run to each back frame and inserted through one of the integral wire clamps (no other fastener is required). Leave some additional wire at every end, in case of a later shift; and dress the wire into the wall cavity, away from the opening.

B. Finish Wiring

When you install the baffle-mounted speakers, the ends of each wire need to be separated, stripped, twisted and inserted into the correct, spring-loaded terminal post. Polarity needs to be maintained—typically +/rib/writing/red/right—for uncompromised performance. The ends of the wires through each terminal post should be pushed over slightly to avoid any contact with the wire strands through the other terminal post or with the crossover circuit board. The terminal posts are spaced so that the wires can be connected, if desired, using standard banana jacks either through the ends or the sides of the posts.

C. Tricks of the Trades—Drilling

When running wire through wooden framing, drill clean holes slightly larger and aligned with each other to be able to pull cable through in longer sections with minimal snagging. Auger style drill bits with threaded tips are self-feeding, can chew through an occasional nail, and save much strain (although they can become jammed in thick timbers). Right angle drills help in narrow spots to get holes drilled and to maintain hole alignment. Short spade bits also get the job done more easily in tight spots between studs.

V. GRILLES

A. Installing and Removing

Install Grilles by aligning one edge and corner against the Finish Frame and then working the edges and corners of the Grille into the Finish Frame—avoiding force which can bend the grill or scratch the edges of the Finish Frame. A putty knife is useful to ease the process

To ensure that Grilles in ceiling locations will not vibrate loose, small dabs of putty can be inserted at several locations into the groove between the Finish Frame and the Baffle before the Grille is inserted and edges embedded. Alternatively, Grille edges can be bent very slightly inward at several spots on each side to "bite" the baffle wall of the groove more securely.

Removing a Grille is most easily accomplished without scratching the finish by inserting an unfolded paper clip or a small brad nail into a perforation and gently pulling forward at several locations near a corner to start the removal.

B. Grille Alternatives—Scrims, Hole Shapes and Sizes

Grilles must be designed for acoustical transparency and also for visual opacity, weather resistance, and paintability. We use aluminum for weather resistance. The relatively small perforations in a slightly thicker material improve paintability and strength, while maintaining acoustical transparency. The removable scrim feature allows the scrim to be removed during grille painting then re-applied, to avoid fabric contamination. The slight decrease in high frequency output is accounted for in the crossover design. If the scrim cannot/is not being used, flip the baffle mounted "HIGH" switch down to optimize the response.

VI. PAINTING

A. Construction Dust and Paint Shield

The Construction Dust and Paint Shield should be installed when the speaker drivers are installed, if construction is not yet completed. The shield fits snugly to protect the drivers. It can be removed after painting and other construction is completed by squeezing the

finger holds in the shield and pulling the shield out from the frame. Construction dust or paint on the speaker drivers will negatively affect their performance and, if significant, void their warranty. If a removable Baffle with drivers will be installed later, the construction dust and paint shield should be installed after the Finish Frame is installed to close the opening and avoid any excess drywall compound, plaster, or paint on the unexposed sections of the Finish Frame.

B. Painting Finish Frames

The Finish Frame is made of ABS plastic and can be painted following standard practices and techniques. Be sure the frame is clean and dry, free of any mold release agent residue and of any construction dust. Lightly and evenly scuff with extra fine sandpaper, rounding square edges slightly, to ensure good paint adhesion. Apply two to three coats, thinned slightly with a paint conditioner, to produce an even surface. Imperfections can be sanded between coats. Spraying will yield best results.

C. Painting Grilles

The Grille is made of painted aluminum and can be painted following standard practices and techniques. Apply two or three coats of paint, thinned well with a paint conditioner to avoid blocking Grille perforations while increasing paint coverage of the sides of the holes. Spraying will yield best results. A roller tends to deposit too much paint, blocking holes. While the paint is wet, blocked holes can be cleared individually with a paper clip, or small nail (#18 wire brad is the closest size). Some excess paint can be removed using a dry brush to pick-up the excess paint and then brushing it out on a scrap of paper or rag and repeating the process. It may be preferable to wipe the wet paint off with thinner or a rag and begin painting more carefully again. With a contrasting color it is important to paint the sides of the perforation holes to show consistent color off axis. This is best done by spraying or brushing carefully from several angles side to side and up and down. Allow a painted Grille to dry thoroughly before carefully installing it in the Finish Frame.

VII. SETUP

A. Swivel Tweeter

The CW160R and CW160S use a unique pivoting SonicGuide™ tweeter. An issue with post mounted coaxial tweeters is that, even the best tweeters, have their response degraded by poor baffling and reflections from the woofer behind them. The SonicGuide is a constant directivity waveguide that greatly improves response smoothness by preventing the sound from radiating backward to the woofer cone. Additionally the SonicGuide can be pivoted and turned to direct the treble energy towards the listeners much as you would angle-in a pair of conventional loudspeakers. The final result is the smoothest possible sound at the listeners position. Additionally, when used as a surround speaker, you may prefer to aim the tweeter away from the ears of listeners to provide more diffuse, less direct sound. A small pivot of the tweeter with listeners nearby, is the equivalent of turning a cabinet speaker slightly.

In either case, carefully pivot the swivel tweeter to aim it towards or away from primary listeners. **Be careful to touch only the plastic perimeter —do not touch the aluminum dome or the plastic phase vane and protector directly in front of the dome. Denting the aluminum dome causes irreparable damage not covered by warranty.**

B. High and Mid Frequencies Switches

In-wall systems are balanced in design for as much bass as possible. Bass is a difficult commodity to deliver in the desired quantity in the limited cavities of in-wall installations. Increasing bass response is effectively decreasing high and mid frequencies response

(regardless of what some labels may indicate).

Adjusted high frequencies response may be desirable when the speakers are installed in locations surrounded by hard surfaces that reflect the sound output with very little absorption, causing a "hardness" to the sound (and/or with some electronics). Adjusted mid frequencies response may be preferred when the speakers are installed close to adjacent walls which can emphasize some upper bass frequencies (and/ or with some electronics). Decreasing mid frequencies is generally desirable to smooth the crossover transition and avoid an upper bass "hump" in systems where bass is supplemented by a subwoofer. Decreasing high and mid frequencies increases relative bass response, while decreasing efficiency and sound power output.

To modify the response, simply flip the baffle-mounted switch or switches to the alternate position—upper, white dot in is the normal position; lower in is the decreased position. These heavy-duty switches are designed to handle the currents of high level sound without compromise.

C. Listening—Balance, Range, and Imaging

Our goal is to provide listeners with completely convincing, "being there" performance. In-wall installations place greater physical limits on systems than freestanding box systems. However, their performance, particularly considering the physical limits and the resulting minimal intrusion into the listening space, can be startling.

Final judgments on the quality of the sound output are of course personal. We encourage listening to the speakers with clear and familiar recordings—particularly of female and male voices and acoustic instruments—to convince and satisfy listeners of the natural tonal balance, wide frequency and dynamic range, and spatial imaging delivered.